

SECTION I: BAA 01- 41 Proposer Information

This section provides further information on Electronic Textiles, the submission, evaluation, and funding processes, proposal and proposal abstract formats, and other general information.

The Defense Advanced Research Projects Agency (DARPA) often selects its research efforts through the Broad Agency Announcement (BAA) process. The BAA will appear in the *Commerce Business Daily*, published by the U. S. Government, Department of Commerce and on the FedBizOpps website, www.fedbizopps.gov . The following information is for those wishing to respond to the BAA.

PROGRAM SCOPE

DARPA is soliciting innovative research proposals in the area of Electronic Textiles. Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state-of-practice.

DARPA seeks innovative proposals to develop a revolutionary approach to integrate textiles and electronics into military applications in a manner that could not otherwise be economically or technically realized. The focus of this program is on developing enabling technologies, fabrication techniques for the economical manufacture of large-area, flexible, conformable information systems and demonstrations of functional prototype systems. Electronic textiles are not expected to compete with high-density, high-performance electronic systems typified by current computer or telecommunications products. Rather, electronic textiles are expected to have unique applications that are typified by the need for flexible and conformable systems or those that can take advantage of the availability of large surface areas (walls, parachutes, aircraft wings, ship hulls, etc.). Distribution of elementary sensors, actuators, logic, and power sources combined with reconfigurable network architectures with fault tolerance and operational longevity is desired. It is expected that lower system costs for these types of applications will be achieved through the use of textile manufacturing processes that are appropriately modified to incorporate electronic components (conventional or yarn based), automated or self-assembled attachment and interconnection techniques, and efficient designs created by the integration of current electronic and textile computer aided design systems.

A key to the success of this program is leveraging the disparate technologies and techniques available within the established electronics and textiles industries. To date there is limited cooperative research among the electronics and textiles communities. It is important to emphasize that the framework for achieving the program objectives is nonexistent. New technologies, new designs, new processes and, most importantly, a new philosophy for designing and fabricating large-scale information systems are crucial to the success of the program. Therefore, both

highly focused proposals and proposals that include multidisciplinary teams are encouraged.

The five-year Electronic Textiles program is divided into two phases. Phase 1 is a 24-month effort with a major emphasis on fundamental technology development. Phase 2 of the program will be focused upon developing specific applications that successfully demonstrate electronic textile capabilities. Proposal requests for Phase 2 are not being made at this time.

Phase 1 proposals that focus on a single task or a subset of tasks 1-5 are acceptable. Proposals that address specific tasks or subsets must incorporate a technology development and insertion plan for higher levels of integration into electronic textile based applications. All multi-task and Task 6 proposals are required to have well-coordinated interdisciplinary research and development teams to address all selected research areas. Teaming among academic, industrial and/or government partners is encouraged, and it is anticipated that the contributions of the team members will be complementary as well as essential to the critical path of the research plan.

APPROACH

The technical approach to the electronic textiles program is to develop and demonstrate the basic electronic textile technologies by leveraging and integrating the necessary knowledge, design capabilities, and manufacturing processes from the materials, textile, microsystems, and information systems communities. There is a broad spectrum of functions that may be incorporated into textiles: (a) sensing, (b) actuation, (c) logic (passive, active), (d) power sources/generation, (e) communication/connectivity, (f) control/adaptation. An evaluation was performed through a series of studies and workshops of the current state of electro-textile research, development complexities, and potential for technology leveraging, plus identifying the key capabilities that must be developed to enable this new field to progress into realizable products. As a result, the major emphasis of this program will be on fiber, filament, and yarn logic (active & passive) functions, communication/connectivity and control/adaptation along with leveraging and enhancing current developments in sensors, actuators, and power sources.

The program is divided into two major focus areas to accomplish the goals of the Electronic Textiles program. The first focus area is component, circuit, and fabrication processes development (Tasks 1, 2, and 3). This development activity will address such activities as:

- Fiber, filament, and yarn and microsystem materials,
- Yarn physical properties and component characterization,
- Textile circuit design and assembly processes, and
- Textile manufacture processes.

The second focus area is information system and application implementation (Tasks 4, 5, and 6). This development activity will address such elements as:

- Application domains and requirements,

- System level control and adaptation concepts,
- Robust algorithms and architectures,
- Network and logic functions, and
- Operating system and resource management.

These two focus areas will be integrated to develop textile application and development tools. This will result in a multi-disciplinary infrastructure for the development of electronic textile systems. A series of early filament, yarn, textile circuit and system demonstrations will be demonstrated to evaluate technical progress and focus technical developments. Since this is a core technology demonstration program, final technology feasibility, use and application recommendations will be documented for potential follow on programs.

The electronic textiles program will be composed of six major tasks: (1) Basic Yarn Component Development, (2) Textile Circuits, (3) Device Manufacturing CAD and Device Simulation, (4) System Simulation, Design, and Modeling, (5) System and Micro Architecture, and (6) Application Analysis and Concept Demonstrations.

Task 1: *Basic Yarn Components Development*

Functional fibers, filaments, and yarns are the basic building blocks of the electronic textiles program. The textile industry has demonstrated a remarkable capability to incorporate both natural and manmade filaments into yarns and fabrics to satisfy a wide range of physical parameters (strength, absorbency, color, durability, etc.) that survive the manufacturing process and are tailored to specific application environments. Preliminary investigations indicate that electronic components can be fabricated within and/or on the surface of filaments and subsequently be processed into functional yarns and woven into fabrics. The emphasis in this task is to explore, develop, test, and characterize a variety of electronic passive and active (logic) filament/yarn components, batteries, actuators and energy conversion devices to determine the feasibility and applicability of their use in functional fabrics. Passive components such as resistors, capacitors, and inductors can be fabricated in several different manners. Diodes and transistors can be made on long, thin, flat strands of silicon or formed in a coaxial manner. Progress has been made in the development of fiber batteries and fiber-based solar cells. In addition, a variety of actuated materials (piezoelectric, etc.) can be made into multiple long strands (filaments) that can form yarns and subsequently be woven into fabric.

Task 2: *Textile Circuits*

Basic yarn components discussed in Task 1, along with conventional filament/yarns, constitute the feedstock of the weaving process. Selectively fed into a loom and manipulated through advanced textile manufacturing processes, this feedstock can be woven into a complex variety of designs that result in a structurally sound, environmentally compatible fabric that provides electrical and mechanical functionality. The formation of electronic circuits from the selective interconnection of fiber components during the weaving process constitutes the basic objective of this task. Interconnection schemes, bussing structures,

distributed power, conventional device attachment, and routing mechanisms will be developed. This task will also determine how current looms can be modified to address the particular needs for interconnecting, routing, and handling of the fiber components. Simple fabric electronic circuits will be designed, fabricated, tested, and characterized. Tests will stress the survivability of the components during the manufacturing and interconnection process as well as environmental and operational stresses (flexibility, durability, etc.) of the composite.

Task 3: Device Manufacturing CAD and Device Simulations

The electronics industry has demonstrated a remarkable ability to develop computer-aided design (CAD) tools for developing complex integrated circuits and printed wiring board products. The textile industry has demonstrated a similar computer-aided design capability for the design and development of advanced fabrics. The emphasis of this task will be the tailoring of existing electronic CAD and the textile CAD tools required for the new electronic textiles manufacturing process. Device and circuit characterization (both electrical and mechanical parameters) developed in Tasks 1 and 2 will be used to develop macros and design libraries and be incorporated into the tailored electronic textiles design tools. This database will be used as a basis for developing device and circuit simulations that will feed into Task 4.

Task 4: System Simulation, Design, and Modeling

The key to performing early electronic textiles technology trades is the ability to accurately predict expected behavior. The unique challenge is to model a range of relatively unpredictable behaviors associated with nano-cells and a connectivity infrastructure. The emphasis of this task will be the development, validation, and updating of early functional and micro-architecture models and simulation environments as the technology evolves over the life of the program. The models and simulation environments developed under this task will be used under Task 5 for electronic textiles system trade-off studies.

Task 5: System and Micro Architecture

The basic micro-architecture tenets that have evolved over time for conventional packaged silicon systems will no longer apply for electronic textiles systems. These basic design trades must now be rethought in conjunction with the basic fiber and microsystem enablers and constraints evolving under Tasks 1 and 2. System robustness is a major design question for electronic textiles. The key to achieving a balanced design is to explore the cost at all levels: fibers, filaments, yarn, woven yarns, micro-architecture, connectivity, run time software, algorithms, and applications. The emphasis of this task will be the development of electronic textile models, simulation tools and application analysis incorporating the real yarn developments and the use of these tools to explore the electronic textiles design space. These efforts will be combined to establish system and micro architecture approaches and demonstrable architectural implementations driven by the requirements of Task 6.

Task 6: Application Analysis and Concept Demonstrations

The overall focus is to provide an information system context framework for the research, development and demonstration of electronic textiles activities in Tasks 1 through 4. Candidate electronic textiles applications and scenarios will be analyzed to provide an iterative design space framework to aid in the system trades to take place at the yarn, textile circuit, and micro-architecture levels. A series of composite heterogeneous device/element behavior and performance simulations and electronic textiles application demonstrations will be performed over the life of the program. Early results during the first two years will guide the development of the basic electronic textiles technologies that will ultimately be incorporated into the final technology integration and demonstration activities during the last three years of the program.

Overall

The research program will follow a systematic approach to identify electronic textiles system characteristics and constraints in parallel with the development of basic yarn components. Incremental demonstrations of fibers, filaments, yarn, textile circuits, discrete fabric prototypes and final electronic textiles applications will occur over the extent of the program.

SUBMISSION PROCESS

The formation of multi-disciplinary teams consisting of industry, academia, and/or national and DoD laboratories with complementary areas of expertise is strongly encouraged. To this end, DARPA invites all interested offerors of whatever size or capacity to provide capability statements to assist with teaming arrangements. An interactive web site has been established at URL <http://teaming.sysplan.com/E-TEX-BAA-01-41/> in which these capability statements will be posted. The web site will remain active from the date of issuance of the BAA until the closing date. Specific information content, communications, networking, and team formation are the sole responsibilities of the participants. Neither DARPA nor the DoD endorses the destination web site or the information and organizations, contained therein, nor does DARPA or the DoD exercise any responsibility at the destination. This web site is provided consistent with the stated purpose of this BAA.

Proposers are strongly encouraged to submit a proposal abstract in advance of a full proposal. This procedure is intended to minimize unnecessary effort in proposal preparation and review. The time and date for submission of proposal abstracts is specified in the BAA. DARPA will acknowledge receipt of the submission and assign a control number that should be used in all further correspondence regarding the proposal abstract.

DARPA will respond to proposal abstracts with a recommendation to propose or not propose. DARPA will attempt to review proposal abstracts within thirty (30) calendar days after receipt and will allow proposers at least thirty (30) calendar days after review of their proposal abstracts in order to complete and submit their full proposals. Proposal abstracts will be reviewed as they are received. Early submissions of proposal abstracts and full proposals are strongly encouraged. Notwithstanding the Proposal Abstract recommendation, the decision to propose

is the responsibility of the proposer. All submitted proposals will be fully reviewed regardless of the disposition of the proposal abstract. Proposers not submitting proposal abstracts are required to submit full proposals by the time and date specified in the BAA.

The typical proposal should express a consolidated effort in support of one or more related technical concepts or ideas. Disjoint efforts should not be included into a single proposal.

Restrictive notices notwithstanding: proposals may be handled, for administrative purposes only, by a support contractor (FAR 37.203 (d) applies). The support contractor performing this role is prohibited from competition in DARPA technical research in this program area and is bound by appropriate nondisclosure requirements. Awards made under this BAA are subject to the provisions of the Federal Acquisition Regulation (FAR) Subpart 9.5, Organizational Conflict of Interest. All offerors and proposed subcontractors must affirmatively state whether they are providing scientific, engineering, and technical assistance (SETA) or similar support to any DARPA technical office(s) through an active contract or subcontract. All affirmations must state which office(s) the offeror supports, and identify the prime contract number. Affirmations should be furnished at the time of proposal submission. All facts relevant to the existence or potential existence of organizational conflicts of interest, as that term is defined in the FAR 9.501, must be disclosed. The disclosure shall include a description of the action the offeror has taken, or proposes to take, to avoid, neutralize, or mitigate such conflict.

Proposals and proposal abstracts may not be submitted by fax or e-mail; any so sent will be disregarded.

EVALUATION CRITERIA/EVALUATION AND FUNDING PROCESSES

Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

For evaluation purposes, a proposal is the two-volume document described in PROPOSAL FORMAT (see below). Other supporting or background materials submitted with the proposal will be considered for the reviewer's convenience only and not considered part of the proposal.

Evaluation of proposals will be accomplished through a technical review of each proposal using the following criteria, which are listed in descending order of relative importance: (1) overall scientific and technical merit, (2) potential contribution and relevance to the DARPA mission, (3) plans and capability to accomplish technology transition, (4) offeror's capabilities and related experience, and (5) cost realism. The cost realism evaluation will consider the value to the Government of the research and the extent to which the proposed management plan will effectively allocate resources to achieve capabilities proposed. As soon as the proposal evaluation is completed, the proposer will be notified of

selectability or non-selectability. Selectable proposals will be considered for funding; non-selectable proposals will be destroyed. (One copy of non-selectable proposals may be retained for file purposes.)

Not all proposals deemed selectable will be funded. Decisions to fund selectable proposals will be based on funds available, scientific and technical merit, and potential contribution and relevance to DARPA mission. Proposals may be considered for funding for a period of up to one year. The Government reserves the right to select for award all, some, or none of the proposals received. All responsible sources capable of satisfying the Government's needs may submit a proposal, which shall be considered by DARPA.

Proposals identified for funding may result in a procurement contract, grant, cooperative agreement, or other transaction depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors. If warranted, portions of resulting awards may be segregated into pre-priced options.

PROPOSAL ABSTRACT FORMAT

Proposal abstracts are strongly encouraged in advance of full proposals in order to provide potential offerors with a rapid response and to minimize unnecessary effort. Proposal abstracts should follow the same general format as described for Volume I under PROPOSAL FORMAT (see below), but include ONLY Sections I and II. The cover sheet should be clearly marked "PROPOSAL ABSTRACT" and the total length should not exceed ten (10) pages. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point and the electronic version shall be submitted on a single 3.5 inch diskette, Iomega Zip disk, or CD ROM following the same guidelines. The page limitation for proposal abstracts includes all figures, tables, and charts. No formal transmittal letter is required.

PROPOSAL FORMAT

All full proposals must be in the format given below. Nonconforming proposals may be rejected without review. Proposals shall consist of two volumes. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point and the electronic version shall be submitted on a single 3.5 inch diskette, Iomega Zip disk, or CD ROM following the same guidelines. The page limitation for full proposals includes all figures, tables, and charts. Volume I, Technical and Management Proposal, may include an attached bibliography of relevant technical papers or research notes (published and unpublished), which document the technical ideas and approach upon which the proposal is based. Copies of not more than three (3) relevant papers can be included with the submission. The bibliography and attached papers are not included in the page counts given below. The submission of other supporting materials along with the proposal is strongly discouraged and will not be considered for review. Except for the attached bibliography, Volume I shall not exceed thirty-eight (38) pages. Maximum page lengths for each section are shown in braces { } below.

Volume I, Technical and Management Proposal

Section I. Administrative

A. {1} Cover sheet to include:

1. BAA number
2. Lead Organization submitting proposal
3. Type of business, selected among the following categories: "LARGE BUSINESS", "SMALL DISADVANTAGED BUSINESS", "OTHER SMALL BUSINESS", "HBCU", "MI", "OTHER EDUCATIONAL", or "OTHER NONPROFIT"
4. Contractor's reference number (if any)
5. Other team members (if applicable) and type of business for each
6. Proposal title
7. Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)
8. Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available), total funds requested from DARPA, and the amount of cost-share (if any)
9. Date proposal was prepared.

B. {1} Official transmittal letter.

Section II. Summary of Proposal

This section provides an overview of the proposed work as well as an introduction to the associated technical and management issues. Further elaboration will be provided in Section III.

A. {2} Innovative claims for the proposed research. This section is the centerpiece of the proposal and should succinctly describe the uniqueness and benefits of the proposed approach relative to the current state-of-the-art and alternate approaches.

B. {1} Deliverables associated with the proposed research and the plans and capability to accomplish technology transition and commercialization. Include in this section all proprietary claims to results, prototypes, intellectual property, or systems supporting and/or necessary for the use of the research, results, and/or prototype. If there are no proprietary claims, this should be stated.

C. {1} Cost, schedule and milestones for the proposed research, including estimates of cost for each task in each year of the effort, total cost and company cost share.

D. {3} Technical rationale, technical approach, and constructive plan for accomplishment of technical goals in support of innovative claims and deliverable production. (In the full proposal, this section should be supplemented by a more detailed plan in Section III.)

E. {1} Schedule Graphic. Provide a graphic representation of the project schedule

including detail down to the individual effort level. This should include but not limited to a multi-phase development plan, which demonstrates a clear understanding of the proposed research; and a plan for periodic and increasingly robust experiments over the project life that will show applicability to the overall concept. Show all project milestones. Use absolute designations for all dates.

F. {1} A clearly defined organization chart for the program team which includes, as applicable: (1) the programmatic relationship of team members, (2) the unique capabilities of team members, (3) the task responsibilities of team members, (4) the teaming strategy among the team members, (5) the key personnel along with the amount of effort to be expended by each person during each year.

Section III. Detailed Proposal Information

This section provides the detailed discussion of the proposed work necessary to enable an in-depth review of the specific technical and managerial issues. Specific attention must be given to addressing both risk and payoff of the proposed work that make it desirable to DARPA.

A. {3} Statement of Work (SOW) written in plain English, outlining the scope of the effort and citing specific tasks to be performed and specific contractor requirements.

B. {2} Description of the results, products, transferable technology, and expected technology transfer path enhancing that of Section II.B.

C. {5} Detailed technical rationale enhancing that of Section II.

D. {5} Detailed technical approach enhancing and completing that of Section II.

E. {3} Comparison with other ongoing research indicating advantages and disadvantages of the proposed effort.

F. {3} Discussion of proposer's previous accomplishments and work in this or closely related research areas.

G. {1} Description of the facilities that would be used for the proposed effort.

H. {5} Cost schedule and milestones for the proposed research, including estimates of cost for each task in each year of the effort, total cost, and any company cost share. Where the effort consists of multiple portions that could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.

Contractors requiring the purchase of information technology (IT) resources as Government Furnished Property (GFP) MUST attach to the submitted proposals the following information:

1. A letter on Corporate letterhead signed by a senior corporate official and

addressed to **(PM's Title & Name)**, DARPA stating that you either can not or will not provide the information technology (IT) resources necessary to conduct the said research.

2. An explanation of the method of competitive acquisition or a sole source justification, as appropriate, for each IT resource item.
3. If the resource is leased, a lease purchase analysis clearly showing the reason for the lease decision.
4. The cost for each IT resource item.

Section IV. Additional Information

A brief bibliography of relevant technical papers and research notes (published and unpublished) which document the technical ideas upon which the proposal is based. Copies of not more than three (3) relevant papers can be included in the submission.

Volume II, Cost Proposal - {No page limit}

A. Cover sheet to include:

1. BAA number
2. Lead Organization submitting proposal
3. Type of business, selected among the following categories: "LARGE BUSINESS", "SMALL DISADVANTAGED BUSINESS", "OTHER SMALL BUSINESS", "HBCU", "MI", "OTHER EDUCATIONAL", or "OTHER NONPROFIT"
4. Contractor's reference number (if any)
5. Other team members (if applicable) and type of business for each
6. Proposal title
7. Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)
8. Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available)
9. Award instrument requested: cost-plus-fixed-fee (CPFF), cost-contract--no fee, cost sharing contract--no fee, or other type of procurement contract (*specify*), grant, cooperative agreement, or other transaction
10. Place(s) and period(s) of performance
11. Total proposed cost separated by basic award and option(s) (if any)
12. Name, address, and telephone number of the offeror's cognizant Defense Contract Management Agency (DCMA) administration office (*if known*)
13. Name, address, and telephone number of the offeror's cognizant Defense Contract Audit Agency (DCAA) audit office (*if known*)
14. Date proposal was prepared

B. Detailed cost breakdown to include:

1. Total program cost broken down by major cost items (direct labor, subcontracts, materials, other direct costs, overhead charges, etc.) and further broken down by year
2. Major program tasks by year
3. An itemization of major subcontracts and equipment purchases
4. An itemization of any information technology (IT)* purchases
5. A summary of projected funding requirements by month
6. The source, nature, and amount of any industry cost-sharing. Where the effort consists of multiple portions that could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.

C. Supporting cost and pricing information in sufficient detail to substantiate the summary cost estimates in B. above. Include a description of the method used to estimate costs and supporting documentation. Note: "cost or pricing data" as defined in FAR Subpart 15.401 shall be required if the offeror is seeking a procurement contract award of \$550,000 or greater unless the offeror requests an exception from the requirement to submit cost or pricing data. "Cost or pricing data" are not required if the offeror proposes an award instrument other than a procurement contract (e.g., a grant, cooperative agreement, or other transaction).

NEW REQUIREMENTS/PROCEDURES: The Award Document for each proposal selected and funded will contain a mandatory requirement for submission of DARPA Quarterly Status Reports and an Annual Project Summary Report. These reports, described below, will be electronically submitted via the DARPA Technical - Financial Information Management System (T-FIMS), utilizing the government furnished Uniform Resource Locator (URL) on the World Wide Web (WWW).

- a. Status Report: Due at least three (3) times per year - Jan, Apr, & Oct

1. Technical Report
 - a. Project General Information
 - b. Technical Approach
 - Accomplishments
 - Goals
 - Significant changes / improvements
 - c. Deliverables
 - d. Transition Plan
 - e. Publications
 - f. Meetings and Presentations
 - g. Project Plans
 - h. Near term Objectives
2. Financial Report
3. Project Status / Schedule

- b. Project Summary (PSUM): Due once each fiscal year in July

1. All Sections of the Status Report
2. QUAD Chart
 - a. Visual Graphic

- b. Impact
- c. New Technical Ideas
- d. Schedule

** IT is defined as "any equipment, or interconnected system(s) or subsystem (s) of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the agency. (a) For purposes of this definition, equipment is used by an agency if the equipment is used by the agency directly or is used by a contractor under a contract with the agency which - (1) Requires the use of such equipment; or (2) Requires the use, to a significant extent, or such equipment in the performance of a service or the furnishing of a product. (b) The term "information technology" includes computers, ancillary, software, firmware and similar procedures, services (including support services), and related resources. (c) The term "information technology" does not include - (1) Any equipment that is acquired by a contractor incidental to a contract; or (2) Any equipment that contains imbedded information technology that is used as an integral part of the product, but the principal function of which is not the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. For example, HVAC (heating, ventilation, and air conditioning) equipment such as thermostats or temperature control devices, and medical equipment where information technology is integral to its operation, are not information technology."*